NPS-GSBPP-07-007

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

The Logistics Impact of Evolutionary Acquisition

26 July 2007

by

Ira Lewis, Associate Professor,

Aruna Apte, Assistant Professor

Graduate School of Business & Public Policy

Naval Postgraduate School

Prepared for: Naval Postgraduate School, Monterey, California 93943

THIS PAGE INTENTIONALLY LEFT BLANK

Naval Postgraduate School
Monterey, California

Daniel T. Oliver
President

Leonard A. Ferrari, Ph.D.
Provost

The Acquisition Chair, Graduate School of Business & Public Policy, Naval Postgraduate School supported the funding of the research presented herein.

The report was prepared by:

____
Ira Lewis, Associate Professor
Graduate School of Business & Public Policy

____
Aruna Apte, Assistant Professor
Graduate School of Business & Public Policy

Reviewed by:

____
Robert N. Beck
Dean, Graduate School of Business & Public Policy

Released by:

____
Dan C. Boger, Ph.D.
Acting Dean of Research

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE

Form approved
OMB No 0704-0188

1. AGENCY USE ONLY (Leave blank)	**2. REPORT DATE** 26 July 2007	**3. REPORT TYPE AND DATES COVERED** 1 October 2006 – 30 June 2007

4. TITLE AND SUBTITLE The Logistics Impact of Evolutionary Acquisition	**5. FUNDING**
6. AUTHOR (S) Ira Lewis and Aruna Apte	
7. PERFORMING ORGANIZATION NAME (S) AND ADDRESS (ES) NAVAL POSTGRADUATE SCHOOL GRADUATE SCHOOL OF BUSINESS AND PUBLIC POLICY 555 DYER ROAD MONTEREY, CA 93943-5103	**8. PERFORMING ORGANIZATION REPORT NUMBER** **NPS-GSBPP-07-007**
9. SPONSORING/MONITORING AGENCY NAME (S) AND ADDRESS (ES)	**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. SUPPLEMENTARY NOTES	
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited	**12b. DISTRIBUTION CODE** **A**

ABSTRACT (Maximum 200 words.)

In 2003, the Department of Defense directed that Evolutionary Acquisition (EA), often referred to as spiral development, become the preferred approach for the acquisition of major weapon systems. Under EA, development, testing, production and fielding of a system take place in increments, once the system reaches a certain stage of maturity. We contend that EA was adopted without consideration of the impact of this approach on logistics support of the system. The result could be degradation of support to each increment of the system and of operational availability. We recommend policy changes that could mitigate the effect of EA on logistics support by elevating the role that logistics play in the testing and milestone approval process for systems acquired using this approach.

14. SUBJECT TERMS Evolutionary Acquisition (EA), spiral development, major weapon systems, logistics support	**15. NUMBER OF PAGES** 51
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT: UNCLASSIFIED	**18. SECURITY CLASSIFICATION OF THIS PAGE:** UNCLASSIFIED	**19. SECURITY CLASSIFICATION OF ABSTRACT:** UNCLASSIFIED	**20. LIMITATION OF ABSTRACT:** UNLIMITED

NSN 7540-01-280-5800

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Abstract

In 2003, the Department of Defense directed that Evolutionary Acquisition (EA), often referred to as spiral development, become the preferred approach for the acquisition of major weapon systems. Under EA, development, testing, production and fielding of a system take place in increments, once the system reaches a certain stage of maturity. We contend that EA was adopted without consideration of the impact of this approach on logistics support of the system. The result could be degradation of support to each increment of the system and of operational availability. We recommend policy changes that could mitigate the effect of EA on logistics support by elevating the role that logistics play in the testing and milestone approval process for systems acquired using this approach.

THIS PAGE INTENTIONALLY LEFT BLANK

About the Authors

Ira Lewis is Associate Professor of Logistics at the Naval Postgraduate School. Prof. Lewis holds a BA and MBA from the University of Ottawa and a PhD in Business Administration (Logistics and Operations Management) from Arizona State University. From 1982 to 1998, he was employed by Canada's Department of National Defence in positions related to logistics, acquisition, and program analysis and evaluation.

Ira Lewis
Graduate School of Business and Public Policy
Naval Postgraduate School
Monterey, CA 93943-5000
Tel: 831-656-2464
Fax: (831) 656-3407
E-mail: ialewis@nps.edu

Dr. Aruna Apte is an Assistant Professor in the department of Operations and Logistics Management, Graduate School of Business and Public Policy, at the Naval Postgraduate School, Monterey, California. She received her PhD in Operations Research from the School of Engineering at Southern Methodist University in Dallas, Texas. She has over twenty years of experience in teaching operations management, operations research, and mathematics courses at the undergraduate and graduate levels in the resident and distance learning programs. Apte has successfully completed various research projects involving applications of mathematical models and optimization techniques. Her research articles have been published in prestigious journals including *Naval Research Logistics* and *Interfaces.* She also has a patent pending for "SONET Ring Designer Tool," created when she worked as a consultant for MCI.

Aruna Apte
Assistant Professor
Graduate School of Business and Public Policy
Naval Postgraduate School
Monterey, CA 93943-5197
Tel: (831) 656-7583
E-mail: auapte@nps.edu

THIS PAGE INTENTIONALLY LEFT BLANK

NPS-GSBPP-07-007

NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

The Logistics Impact of Evolutionary Acquisition

26 July 2007

by

Ira Lewis, Associate Professor,

Aruna Apte, Assistant Professor

Graduate School of Business & Public Policy

Naval Postgraduate School

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

THIS PAGE INTENTIONALLY LEFT BLANK

Introduction

Evolutionary Acquisition (EA), sometimes referred to as spiral development (SD), is a program-management approach intended to reduce the cost of weapon systems by faster fielding, reduced development costs and a greater opportunity to assess operational performance before the end of production (Gansler & Lucyshyn, 2005, August, p. 28). EA has been defined as follows:

> Evolutionary acquisition is the preferred DOD strategy for rapid acquisition of mature technology for the user. An evolutionary approach delivers capability in increments, recognizing, up front, the need for future capability improvements. The objective is to balance needs and available capability with resources, and to put capability into the hands of the user quickly. The success of the strategy depends on consistent and continuous definition of requirements, and the maturation of technologies that lead to disciplined development and production of systems that provide increasing capability towards a materiel concept. (Retrieved June 28, 2007 from Acquisition Community Connection portal, https://acc.dau.mil, definition of Evolutionary Acquisition, Undated, no stable URL)

While EA is distinctly attractive from the program-management viewpoint, the process could lead to a proliferation of configurations (sometimes called “blocks”) of a given weapon system, an issue that arises even with traditional acquisition practices (sometimes referred to as “single step to full capability” (SSFC)) (Congressional Research Service, 2006, May 17).

For instance, in 2003, the Phalanx Close-In Weapon System (CIWS) was employed on 158 ships and featured 308 mounts and 6 baseline configurations. Diversity of the system due to different baselines creates unique problems arising out of the unique status of the mounts. The different baselines for all these mounts necessitate increased logistical complexity to provide necessary spares; this complexity likewise causes increased lack of availability of the maintenance expertise on the ship and places a heavy burden on inventory managers to carry the required spare parts (Apte, 2004, October 1).

In short, as configurations proliferate, due to either SSFC or evolutionary acquisition policies, so do the logistics challenges of supporting the system, particularly in the areas of supply and maintenance. The block approach in the past has had the same problem due to unscheduled, unforeseen maintenance. A common consequence of a spiral approach may be an increase in the diversity of parts and, hence, logistics complexity (Apte, 2005, June). The saving grace for the spiral approach may be that its requirements are planned and forecasted due to the structure of the process. The spiral approach may have major implications for DOD budgeting, spare parts support, maintenance, and training.

A recent GAO report described the major challenges associated with the compressed schedule for development of the F-35 Lightning II Joint Strike Fighter (JSF), including logistics supportability. It is notable that the JSF program office has not adopted the established EA approach, but a variant meant to meet the unique constraints and requirements of that program (GAO, 2006, March 16). A USAF author has also expressed a certain degree of caution regarding the sustainment of systems developed using EA:

> While some basic truths never change, Evolutionary Acquisition does, at the same time, pose major new and unique challenges for the support community. Planning can be more complex when attempting to support multiple increments, rather than one final delivery. The issues of configuration control and interoperability rise rapidly to the forefront of the planning effort, as incremental introduction of warfighting capability increases the chances of multiple versions of weapon systems being in use simultaneously.
>
> Proper planning should allow for a much more structured approach to configuration management, which should, in turn, mitigate the risks associated with multiple versions and interoperability. Ensuring full-up support capability is garnered more rapidly to match the quicker delivery of a weapon system operational capability is also among the most basic of those challenges. For these reasons, thorough logistics support planning and finely tuned, integrated, and coordinated support execution are even more important than in the past. (Farmer, 2003, Spring, pp. 27-34)

A recent National Research Council (NRC) report expressed similar concerns about the logistics support aspects of EA at the level of operational test and evaluation. The NAS concluded that structures were not currently in place to ensure

that system deficiencies and the nature of operational failures would be identified to those organizations responsible for providing support of the fielded system, thus ensuring appropriate action could be taken at a sufficiently early stage (Nair & Cohen, 2006, p. 4).

The interplay of EA and logistics, therefore, appears to offer a fruitful area for further research. There is the opportunity to identify EA criteria and decision points—where logistics considerations could play a major role in determining the downstream supportability of a weapon system, perhaps even to a greater degree that with traditional acquisition.

Since EA remains in its formative stages, and no major weapon system has yet been developed and fielded using this approach, there is an opportunity to more fully explore EA policy with a view to identifying areas where logistics support issues could be more fully addressed.

It is hoped that this paper will serve to inform the refinement of EA policy and practice as it relates to logistics support. Our goals are the following:

- Define the relationship of EA to logistics support, particularly with respect to the fielding of multiple configurations;
- Establish the specific areas of logistics support that are most affected by EA;
- Determine which evaluation criteria and decision-making processes in EA relate to logistics support;
- Recommend approaches that could increase the visibility and degree of integration of logistics factors in the EA of weapon systems.

THIS PAGE INTENTIONALLY LEFT BLANK

Policy Context

Policy direction on EA has been codified through the two key documents governing the DOD acquisition system—the *DODD 5000.1* and *DODI 5000.2*. EA is first established as the "preferred approach" as follows:

> 4.3. The following policies shall govern the Defense Acquisition System:
>
> […]
>
> 4.3.2. Responsiveness. Advanced technology shall be integrated into producible systems and deployed in the shortest time practicable. Approved, time-phased capability needs matched with available technology and resources enable evolutionary acquisition strategies. *Evolutionary acquisition strategies are the preferred approach to satisfying operational needs*. Spiral development is the preferred process for executing such strategies. (DOD, 2003, November 24, paragraph 4.3; emphasis added)

The above Directive, however, does not define what is meant by either evolutionary acquisition or SD. Further explanation is given in the accompanying Instruction:

> 3.3. Evolutionary Acquisition
>
> 3.3.1. Evolutionary acquisition is the preferred DOD strategy for rapid acquisition of mature technology for the user. *An evolutionary approach delivers capability in increments, recognizing, up front, the need for future capability improvements. The objective is to balance needs and available capability with resources, and to put capability into the hands of the user quickly.* The success of the strategy depends on consistent and continuous definition of requirements, and the maturation of technologies that lead to disciplined development and production of systems that provide increasing capability towards a materiel concept.
>
> 3.3.2. The approaches to achieve evolutionary acquisition require collaboration between the user, tester, and developer. They include:
>
> 3.3.2.1. *Spiral Development. In this process, a desired capability is identified, but the end-state requirements are not known at program initiation*. Those requirements are refined through demonstration and risk management; there is continuous user feedback; and each increment provides the user the best possible capability. The requirements for future increments depend on feedback from users and technology maturation.

> 3.3.2.2. Incremental Development. In this process, a desired capability is identified, an end-state requirement is known, and that requirement is met over time by developing several increments, each dependent on available mature technology. (DOD, 2003, May 12, paragraph 3.3; emphasis added)

In simpler terms, two key points emerge from the above guidance:

1. Systems are to be developed, produced, tested and fielded "incrementally" as they reach what are considered to be an acceptable state of maturity. The systems will eventually emerge in a series of increments, sometimes referred to as "blocks"—each of which reflects the maturity of the system at the time of fielding.

2. The stated preference for SD over incremental development indicates that systems should arguably be fielded without knowledge of the end-state requirement.

It is fairly straightforward to understand what brought about the desire for EA and SD. The fact that the DOD (generally) takes too long to develop, produce and field weapon systems, which are too expensive, too difficult to operate and support, and that they often do not meet user requirements is a truism that is somewhat redundant to state here.[1] Finally, cost escalation and the stretched-out nature of the acquisition of major systems such as ships or aircraft eventually leads to far fewer of the end items being delivered than originally envisaged. For example, the Air Force originally stated a requirement for a quantity of 381 of the F-22A Raptor fighter aircraft, but now can only afford to buy 183—at a considerably higher unit cost (GAO, 2006, June 20). This syndrome, which is more the rule than the exception for major systems acquisition, has been termed the "Conspiracy of Hope," in which products require decades to deliver and cost far more than originally planned (Defense Acquisition Performance Assessment Project, 2006, February, p. 48).

---

[1] The reader is referred to the large number of US Government Accountability Office reports and testimonies on the subject of defense acquisition problems (www.gao.gov), as well as studies by the RAND Corporation (www.rand.org) and audits by the DOD Inspector General (www.DODig.osd.mil). Congress and the DOD have also commissioned numerous external ("Blue Ribbon") reviews of the same issue since at least the 1970s, a recent example of which is the *Report* of the Defense Acquisition Performance Assessment Project (2006, February; see www.acq.osd.mil/dapaproject/). Finally, the Naval Postgraduate School's Acquisition Research Program has funded reports on many aspects of current defense acquisition challenges; see www.acquisitionresearch.org.

The policy response to the above longstanding answer makes intuitive sense. Rather than spend what sometimes ends up being decades developing the ultimate weapon system, the DOD can “freeze” the system under development at certain intervals. Production and fielding of the corresponding “increment” will soon follow. As the system matures based on technical advances and user feedback, more advanced models will be developed. The result: more systems in operation, in less elapsed time, at a lower unit cost.

THIS PAGE INTENTIONALLY LEFT BLANK

Original Intentions and Implementation Challenges

The 2003 direction with respect to acquisition generally, and EA in particular, may inevitably lead to greater challenges once the system is actually fielded. The military units operating the system will be faced with what could be a large number of different "increments" of the same system. Each increment may have unique operational, maintenance, supply, training and personnel requirements. Accordingly, the advantages of commonality associated with a long production run of identical items are lost in favor of getting the system fielded sooner.

As stated simply by the GAO, "Programs that start with mature technologies do better" (GAO, 2006, March). The traditional approach to DOD major systems acquisition has been described "bleeding-edge" or "gold-plated," meaning that systems are put into either Low-rate Initial Production (LRIP) or even full production without meaningful testing or technology maturity. For example, the GAO has stated that the JSF is expected to enter LRIP with only 1% of the flight testing having been completed. This is because financial programming constraints force the developmental, testing, and production phases to become "pancaked" to the point of overlap (GAO, 2006, March 16).

EA has been intended to mitigate the above problem by dividing each major program into increments. Within each increment, each of the principal milestones associated with the acquisition of a system must be met, beginning at milestone B (approval for initiation of the System Development and Demonstration phase).[2] According to the report of the NRC workshop cited above, the introduction of EA as the "preferred approach" for major DOD systems acquisition has significant benefits in preventing requirements creep or gold-plating by creating more opportunities for senior management input:

---

[2] A useful chart of the nested, cyclical nature of the acquisition approval process using EA is found in Dillard (2003, September 29, p. 47).

> Evolutionary Acquisition provides increased opportunities to better discipline the management of acquisition programs. Decision makers can weed out unwarranted optimism in draft “requirements” and choose only mature technologies to include in the early stages of acquisition programs. They can delay the introduction of risky, immature technology to future stages. […] Demonstrating technological maturity before including the technology in a formal acquisition program will eliminate the need to delay the entire acquisition program because of one risky technology area or risk using technology that not be sufficiently effective or reliable. (Nair & Cohen, 2006, p. 23)

John Dillard has suggested a contrasting viewpoint to the above optimism. He emphasizes that the 2003 *DODI 5000.2* and *DODD 5000.1*significantly increase the reporting burden on program managers and elevate the milestone decision authority (MDA) for each stage of the program one or more levels higher than previously. In doing so, the 2003 policy has the effect of further demoting the attention that PMs and their staffs can devote to actually managing the acquisition—which would include providing logistics support (Dillard, 2003, September 29, p. 54).

In Dillard’s view, increased centralization represents an attempt to “take control” without remedying many inherently chaotic and contradictory features of the acquisition system, such as the conflict between program approvals and the availability of funds to execute the appropriate phase. EA is described as a “management control mechanism” where the “time and effort on control activities appears almost certainly excessive within the same delivery timeline” (Dillard, 2003, September 29, p. 47). In support of that viewpoint, the CRS has suggested to Congress that EA may require additional legislative oversight as compared to SSFC programs (Congressional Research Service, 2006, May 17).

The paradox is that the 2003 DOD direction clearly and repeatedly states that support requirements are a key performance parameter for the acquisition of any weapon system. However, with the multiplication of configurations generated by EA, and with the preference for SD suggesting that end-state requirements are not known at program initiation (and perhaps much later), the support requirements for the system acquired under EA may become significantly more complex.

The DOD has long been criticized for its lack of performance in supporting existing systems that are acquired in a traditional manner, using a smaller number of different versions than would be contemplated by EA. The GAO has designated DOD weapon systems acquisition and supply-chain management as two “high risk” areas continuously to each new Congress from 1990 to 2007 (GAO, 2007, January). If EA is successful at improving the first, what measures might need to be taken to mitigate negative impacts on the second, should that prove to be the case? While some parts of the DOD and the defense industry might be rewarded for EA, if the resulting systems are significantly more difficult to support, operational effectiveness would be compromised. As explained by the GAO, “DOD does not have an environment that facilitates effective program management” (GAO, 2007, March).

The DOD’s unfathomable size and complexity make almost any reforms difficult. But it is clear that all support systems need to be in place for a weapon system to be functional. EA, with its emphasis on rapid fielding, will require significant emphasis on sufficient funding and agile reconfiguration of all support systems (including training) that are related to each new increment. The DOD’s performance in SSFC systems has been less than desirable and has long been viewed as “high risk”—with inadequate progress being made to address support issues over the past two decades. In addition to the cautions of the GAO, the Congressional Research Service has offered the following view:

> Under SSFC, DOD provided information about the entire projected program, stretching many years into the future. Such information, supporters of EA/SD argue, may appear more complete, but is not very reliable because it requires projecting program related events well into the future. DOD’s history in accurately projecting such events, they argue, is far from perfect. As a result, they argue, information provided in connection with an SSFC weapon acquisition program can give Congress the illusion—but not the reality—of understanding the outlines of the entire program. On the other hand, critics of EA/SD contend that it has the potential for drawing Congress into programs to a point where extrication becomes difficult if not impossible, and without a clear idea of a program’s ultimate objectives. (2006, May 17)

EA will require not only that the current significant deficiencies with respect to weapon system support be effectively addressed, but that the responsiveness of the

massive support "tail" be improved by several orders of magnitude. Otherwise, the cost in degradation of operational availability of incrementally fielded systems may be very high to the warfighter.

Given that the latest version of *DODI 5000.2* and *DODD 5000.1* were only adopted in 2003, it is too early to attempt to locate lessons learned on the impact of EA on logistics (or other types of) support to weapon systems. It was noted above that the largest acquisition program in DOD history, the JSF, is not following the EA methodology (GAO, 2006, March 16). A somewhat caustic but relevant insight with respect to EA's impact on logistics was located in a RAND study of EA in defense space programs:

> In the colorful phrase of one program manager, it is crucial for EA program managers to recognize and plan for the fact that "logistics takes it in the shorts" in EA programs. What is meant by this colorful phrase is that EA greatly complicates logistics planning (and life-cycle cost analysis) by leading to a proliferation of different system configurations as the system evolves through its increments or spirals. The best approach to dealing with this challenge, in the view of several program managers, is to plan from the beginning to back-fit earlier variants to bring them up to the standard of the latest configurations, or merely to replace old variants with the current versions. The KEI [Kinetic Energy Interceptor] program manager suggests a "blast down" solution for old variants, where the earlier versions are consumed through use as test vehicles for later stages of the program. Whatever the approach, budget planners, cost analysts, and logistics planners must be prepared to anticipate and plan for the additional complexities and costs that will be incurred through the use of EA by the fielding of multiple versions and configurations of the same system. (Lorell, Lowell & Younossi, 2006, p. 84-85)

It is of interest that the RAND study cited above deals with space systems, which could, therefore, be viewed as understating the logistics problem dealing with physically larger and more complex systems. Current DOD policy does not, indeed, address what will happen to weapons from older increments as the newer models are rolled out. There are many options, some of them due to the nature of the system and the types of improvements made (i.e., technical issues). In the case of the RQ-4A Global Hawk unmanned aerial vehicle, which has been acquired using spiral development (SD), the following comment has been made:

> One [Global Hawk] manager stated, “keeping track of spares requirements with multiple configurations is very challenging as each spiral is very different.” This adversely affects LCC [lifecycle cost] since a larger logistical footprint increases O&M [Operations and Maintenance] funding dramatically.
>
> As with any spirally developed program, the Global Hawk program plans to add several different capabilities in each spiral. One result of this is differing sparing requirements between spirals. Each spiral could have vastly different components, thus, multiple types of spare parts for those different components. This could become a nightmare for a parts manager.
>
> […]
>
> Since spares are so critical for operational effectiveness, logisticians must study spares tradeoffs and encourage parts commonality between spirals. This is a challenge for the Global Hawk program as it has roughly only 10 percent parts commonality between the A model and B model.

A potential solution to the spares requirements for different spirals is to utilize a modular systems approach. If future components “plug and play” with the current system architecture, the version of the component used for repair purposes would not have as great an impact (Henning & Walter, 2005, December, p. 46). One of the authors has noted in previous research that:

> Combining modularization with Spiral Development has the following advantages. Most importantly, the combination will reduce logistic complexity. In the private sector, modularization has achieved great results. By tailoring it to the DOD’s needs, similar results could be achieved. One of the advantages in the private sector is that customers find it easier to make their purchase decisions when their initial investment is not completely lost by subsequent introduction of superior products. In the DOD, the acquisition programs represent the customer. So here, commitment to localizing performance improvements and modular development is more effective than integral architecture. In other words, amongst defense initiatives, open architecture is a “good thing.” Modular designs are more conducive to a faster launch; therefore, from a warfighter’s view, modularity would definitely be a great advantage. Likewise, using standard components, a NPMU approach might be an attractive option when cost-side advantages are factored in. With costs skyrocketing and ships being run as private enterprises, this aspect of modularization is worth investigating. (Apte, 2005, June, p. 23)

But there are also potential problems dealing with finding adequate funding to upgrade older models, turn them into test articles or training equipment, or even

dispose of them (i.e., budgetary, administrative and other bureaucratic constraints). Following the advice in the quotation above with respect to an old-model Global Hawk UAV (such as the “blast down” suggested previously) may make sense, but what action should be taken with a prior-increment destroyer? DOD policy is emphatic on the need to plan for and support systems throughout their lifecycles, but it cannot be assumed that doing so is practical, reasonable, or affordable. For example, *DODI 5000.2* requires that:

> 3.9.2.2. Effective sustainment of weapon systems begins with the design and development of reliable and maintainable systems through the continuous application of a robust systems engineering methodology.
>
> […]
>
> 3.9.2.3. The PM [Program Manager] shall work with the users to document performance and support requirements in performance agreements specifying objective outcomes, measures, resource commitments, and stakeholder responsibilities. The Military Services shall document sustainment procedures that ensure integrated combat support.

Within the context of EA, *DODD 5000.2* attempts to address the issue of support in the early stages of an acquisition program by requiring a Technology Development Strategy (TDS) following Milestone A (Concept Refinement) approval (emphasis added):

> 3.5.4. […] The TDS shall document the following:
>
> 3.5.4.1. The rationale for adopting an evolutionary strategy (for most programs) or a single-step-to-full-capability strategy (e.g., for common supply items or COTS [Commercial Off-the-shelf] items). For an evolutionary acquisition, either spiral or incremental, the TDS shall include a preliminary description of how the program will be divided into technology spirals and development increments, an appropriate limitation on the number of prototype units that may be produced and deployed during technology development, *how these units will be supported*, and specific performance goals and exit criteria that must be met before exceeding the number of prototypes that may be produced under the research and development program.

Similar requirements with respect to logistics support for all acquisition programs are also included in guidance on later stages of the acquisition process (see *DODD 5000.2,* paragraphs 3.7.1.1., 3.8.2, and 3.9.2.1). A Delphi study of Air

Force acquisition personnel involved in EA programs found that these requirements were not sufficient to ensure adequate support for evolutionary programs, given that financial constraints ultimately became the key constraint. The author defined "brick-wall constraints" as "those that cannot be overcome and are considered unalterable," (Wellman, 2003, p. 43) as follows:

> The Government funding process was overwhelmingly identified as one of the main constraints in implementing an EA strategy. The main roadblocks mentioned were the availability and timing of funds, the color of money, and the affordability of the increments. Often, the approved funding level actually dictates the requirements. Problems occur when the contractor's spend plan exceeds the approved funding level for the particular program.

Sufficient and appropriate levels of funding are essential to the success of an EA. While suggestions were made on how to improve this process, it should be considered a brick-wall constraint since only Congressional intervention will make any lasting change (Wellman, 2003, p. 45). This view has also been supported by the Congressional Research Service (2006, May 17).

Similarly, Dillard has noted that:

> a special challenge is presented for obtaining realistic full funding estimates for programs with uncertain requirements and numbers of increments. If, indeed, shorter cycles are facilitated by an EA, skillful financial management (programming and budgeting) will be required to effectively enable the availability of funding as requirements for successive blocks are realized. (Dillard, 2003, September 29, p. 49)

Dillard, accordingly, believed that EA, combined with increased reporting burdens and higher approval levels, could actually lengthen acquisition programs (p. 1). The logistics support process for EA, therefore, finds itself caught between lofty, recent and theoretically sufficient direction and the traditional contradictions of defense acquisition. Dillard's view is supported by the GAO, writing four years after the adoption of EA, explaining that, "our work has shown that program managers are not empowered to execute acquisition programs nor are they set up to be accountable for the results" (GAO, 2007, January).

Certainly, EA will exacerbate current support problems unless the increased complexity of support associated with EA is at least compensated for by increased, dedicated funding and better planning for support requirements. The increased reliance on contractors for almost every aspect of acquisition management also stands the chance of increasing the number of levels of management and, thus, the potential for distortions of information within the acquisition process.

Weapon systems have always evolved throughout their lifecycles. Even a single model of a system acquired over a long term will have different “blocks” of production with configuration differences. As well, variants of a single system are often produced intentionally, such as single- and two-seat fighter aircraft. Other systems, such as the Boeing B-52H, the Boeing C-135/C-137 Stratotanker/Stratoliner or the Lockheed Martin C-130 Hercules, exist in innumerable configurations.

An excellent example of long-term, SSFC acquisition that incorporates considered evolution is the DDG-51 ARLEIGH BURKE-class destroyer. The first (namesake) ship in this class was ordered in 1985 and commissioned in 1991, yet production continues as of 2007. Current plans call for a total of 62 or more of these ships to be built. The ship has evolved gradually, creating a new “Flight” (or block) when certain major changes in configuration or technology occur.

The DDG-51 class is an example of a well-managed, long-term program that uses traditional acquisition processes to deliver weapon systems without the need for concurrent activity . (Department of the Navy, Undated; Federation of American Scientists, Undated). In comparison, the upcoming DDG-1000 (ZUMWALT Class destroyer) will be built using EA. Given that this last system has been plagued by development delays and renamed several times, the DDG-51 class, with its established production line and stable design, may end up including more ships than originally envisaged, serving far more than the usual 30-35 year lifespan for Navy combat vessels, because of delays in DDG-1000 development and production, which EA may exacerbate (Congressional Research Service, 2006, May 17).

The GAO has pointed out that delays in acquiring future systems will mean extending the life of (and in some cases manufacturing more copies of) existing systems. For example, major work may be necessary on the Boeing F/A-18 C/D Hornet if JSF deliveries lag, and the Boeing F-15E Eagle may need its service life extended for the same reason (GAO, 2007, April). It is difficult to predict which will take priority—increased expenditures to maintain legacy systems or increased expenditures to buy future systems—but the outlook makes financial decision-making very challenging

THIS PAGE INTENTIONALLY LEFT BLANK

From Software to Everywhere

Given that the DODD and DODI promulgating EA as a “preferred approach” date only to 2003, one cannot make even preliminary conclusions about the merits of EA or its deficiencies since no systems have yet been fielded in all their increments. We will, therefore, take a look backward to better understand how EA became a central concept in major acquisition program management.

Some discussion of how “policy creep” occurs in government may be of interest here. The software industry has had significant experience with various types of “spiral development” conducted using the rigorous norms of the Capability Maturity Model Integration (CMMI) of the Software Engineering Institute (SEI), a non-profit, Federally Funded Research and Development Center (FFRDC). The SEI’s work with respect to defense acquisition is focused on software-intensive systems and includes a dedicated CMMI Acquisition Management module, which is introduced as follows:

> The congressional and Department of Defense (DOD)-level guidance that remains in place emphasizes software acquisition process improvement, including the measurement of process performance. The goal of this guidance is to influence the outcome of the acquisition process, delivering the right capabilities to operational users, on schedule, and at predictable costs. One way to meet this goal is through the disciplined application of effective acquisition processes. Applying this approach, however, requires renewed dedication to defining, implementing, measuring, and maintaining the acquisition processes fundamental to a technically sound project.
>
> The purpose of this document is to define effective and efficient acquisition practices that focus on the activities performed by acquisition professionals inside the acquisition program office. The best practices also address internal program office activities that support the monitoring and control of external development contractors and suppliers. Best practices provide a basis for acquisition process discipline, while balancing the need for agility. Note, however, that this report identifies acquisition practices that should be implemented, but does not prescribe specific implementation approaches. (Software Engineering Institute, 2005, May).

The SEI’s work on EA (which they term “software acquisition process improvement”), therefore, assumes that a coherent management-control framework

is in place, giving sufficient guidance to program managers and minimizing contradictory guidance. Additionally, specific approaches (i.e., just how to do EA) are not provided. Other SEI publications delve more into implementation, but once more, usually envisage a certain managerial or leadership framework.

Spiral development's success in the software industry was "acquired" by OSD; the process may have found its way into top-level guidance on all DOD acquisition without policy-makers adequately addressing the complexities of implementation, unforeseen additional costs, or impact on logistics support. As a RAND report has explained, "EA was first applied to software-dominated Command, Control, Communications and Intelligence (C3I) systems in which change was occurring so rapidly that is was difficult to define in detail the operational capabilities before starting EMD [Engineering Manufacturing and Development]" (Stern, Boito & Younossi, 2006, p. 48).

While modern software, particularly for weapon systems, can be extremely complex, it does not have the physical qualities and support requirements associated with, for example, a tank or a ship. Nevertheless, software requirements for modern systems have become a significant factor in acquisition; for example, the AC-130 Spooky gunship is reputed to be the most complex aircraft currently flying, incorporating over 609,000 lines of software code in multiple mission systems (Federation of American Scientists, Undated).

In effect, the "technology transfer" of the CMMI as a conceptual (and probably successful) software acquisition approach within SEI to EA as a cornerstone policy for all acquisitions within the *DODI 5000.1* and *DODD 5000.2* major acquisition program framework may have occurred a little too brusquely, borne partly out of frustration with the perceived inadequacies of the DOD acquisition process we described earlier.

Additionally, studies exploring the CMMI's potential use beyond software acquisition, such as one by the Aerospace Corporation (another FFRDC), may have played a role in influencing the Office of the Secretary of Defense's policy-makers

(Hantos, 2005, September 30). The result, unfortunately, may end up complicating an already complex system and further increasing cost while degrading acquisition cycle-time and supportability, as suggested by Dillard (2003, September 29).

The RAND study mentioned above qualified its support for the EA concept by stating that:

> the [EA] process requires additional capability to be released in a series of overlapping "spirals." Each spiral has some dependence on the work from the previous spiral but also adds unique capability. Each spiral also has its own oversight review process that needs to be addressed.

EA would seem to increase the complexity of the effort required by SE/PM [systems engineering/program management] personnel because requirements must be redefined for each successive iteration or spiral. *Presumably, this constant change in the development baseline, in which one design will be fielded in the short term while another design is being developed, makes it difficult to maintain configuration control of the different systems resulting from each spiral. This situation results in a continual trade-off among changing needs and desired capability and the finite resources to perform a task.* (Stern et al., 2006, p. 118-119; emphasis added)

Given the oft-repeated concerns about the support of traditionally acquired systems we discussed previously, it would seem reasonable to speculate that logistics requirements for EA programs will fall even farther down the list of priorities given the "finite resources" (generally money and manpower, but sometimes technology) at the PM's or contractor's disposal. The financial management and support issues associated with the acquisition of the Global Hawk unmanned aerial vehicle, a relatively small program, may be a harbinger of what can be expected when EA begins to be implemented throughout the acquisition community:

Another complication mentioned by the Global Hawk cost analyst is that SD runs counter to the sequence of development, production, and operating and support lifecycle phases. Successive spirals being released to the end-user result in overlap of the lifecycle phases. A change in design could affect the building of units

that are currently in production or could require retrofits for units that are already fielded. These concurrent phases require a large amount of coordination at all times to ensure that the program strategy is continuously followed between the program phases.

The implications of the complexities of EA for cost estimating are that while EA possibly reduces technical risk by allowing for partial solutions to be fielded more quickly, it may incur increased costs due to increased coordination, integration, and logistics activities for SE/PM. Estimators should divide their SE/PM cost estimates into two parts: the SE/PM cost related to specific spirals or increments and the "overlay" SE/PM cost for the effort that continues across multiple spirals and that provides consistency of overall program direction. Because each spiral or increment may be shifted in the schedule according to the priorities of the program's end-users, estimators must be able to determine the unique amount of SE/PM cost required for each spiral or increment. This ability allows for rapid, modular changes to be made to the cost estimate. Also, logistics planners prefer that design changes be "settled out" before performing a full LSA [Logistics Support Analysis]. However, the rush to field systems may push a system to the user before a logistics infrastructure has been established to support the fielded units. Also, as various spirals are fielded, they may or may not include retrofitting to bring older units in line with a common configuration, making configuration control difficult to maintain (Stern et al., 2006, p. 120; emphasis added).

Similarly, it has been noted, "The logistics community must buy into having multiple configurations fielded. Fortunately, commonality and modularity at the component and subcomponent level should help reduce some of the logistics burden" (Johnson & Birmingham, 2005). This would appear to be somewhat of an understatement. As is often the case in government, policies such as the 2003 5000 Directives are somewhat lacking in a sound approach to implementation.

The traditional solution, as offered in the above quotation, is to blame working-level staff members (in this case logisticians, maintenance or engineering

staffs) for inadequate “buy-in” or resistance to change. Senior-level policy-makers bear the responsibility for being evaluated on the results of their work in terms of *implementation* of policy, not simply its *publication*. This shift in thinking and reward mechanisms, which has occurred throughout the major Commonwealth nations (Australia, Canada, New Zealand and the United Kingdom) since the 1980s, is known as “New Public Management” (NPM) or now simply “Public Management.”[3]

A key part of NPM is the reduction in the legislative and regulatory burden faced by senior officials so that better performance can be expected at lower cost. The DOD has not adopted any notable aspect of EA and preserves its existing “checks and balances” regime of statutory and regulatory controls over every aspect of DOD business (including contracting), none of which were relaxed with the creation of EA. The issues of whether the US is simply lagging by inertia in its implementation of public management concepts, or whether the true reasons are political or constitutional, are of interest; but, unfortunately, they are beyond the scope of this paper.

Accordingly, the DOD could arguably be left with a collection of unsupportable and incompatible systems that took little or no less time to develop than under the traditional single-stage acquisition (and logistics planning) process. And the increased workload on PMs imposed by EA may end up degrading the potential for the later increments of a system to be developed, manufactured, fielded or supported. As suggested by three faculty members at the Air Force Institute of Technology, under EA, “Configuration management deserves increased attention […] each increment must be fully supportable in an affordable manner” (Farmer, Frichtman & Farkas, 2003).

---

[3] For a sound overview of these changes, see Barzelay (2001). For a comprehensive examination of public management in the US and other nations from a comparative perspective see Pollitt and Bouckaert (2004). See also Jones and Kettl (2003).

THIS PAGE INTENTIONALLY LEFT BLANK

Toward a Workable Approach

The "Conspiracy of Hope" (in which cost and time is underestimated) mentioned in the *Report* of the Defense Acquisition Performance Assessment project[4] is only one of the paradoxes affecting the DOD major systems acquisition process. Another is the inevitable paradox between the perceptual short-term timeframes of senior decision-makers (who are on the job for only a few years, whether they are flag officers or political appointees) and the long-term nature of the approval, development, production, fielding and operation of major systems.

From the perspective of the New Public Management paradigm mentioned above, this system makes no sense as it is impossible to hold senior management accountable because it is impossible to make any reference to actual implementation.

The solution, as some DOD policy-makers have suggested when a crisis occurs or when the opportunity arises to make new policy, is to increase "discipline" and "buy-in" because program offices and other staff involved with actually supporting these systems need to change their behavior (Stern et al., 2006, p. 120). Dillard has pointed out that the 2003 amendments implementing EA as a "preferred approach" will, in fact, further degrade the capability of staffs to "get with the program" and, supposedly, to deliver and field major systems on time and at the originally planned cost (Dillard, 2003, September 29, p. 1).

Since support issues such as logistics are, by definition, "downstream" issues which will fall to the bottom of the priority list during the peak years of effort on weapon systems, a practical solution is needed. The fact that those PMs who happen to work on systems that use the "preferred approach" of EA will be working on several increments *concurrently* that are at *different stages in the acquisition process* can only be seen as exacerbating the problem, even with the requirement of

[4] See note 3 above.

“user feedback” from prior increments (DOD, 2003, November 24, paragraph 3.3.2.1; DOD, 2003, May 12, paragraph 3.3; emphasis added).

In our research, we were struck by the importance and independence of operational testing and evaluation (OT&E) at various stages of the acquisition process. Under current rules, the OT&E process has to be repeated at each required stage for each spiral. In a parallel vein, both the GAO and the DOD are placing emphasis on “technology maturity,” a term perhaps borrowed from NASA’s use of “Technology Readiness Levels” (TRLs) and the SEI’s use of the Capability Maturity Model Integration (NASA, Undated,; Software Engineering Institute, 2005, May).

We would suggest that there are two preconditions to ensuring adequate logistics support for major systems acquired under EA. First, the definition of OT&E and related independent testing must include all aspects of logistics for each increment of a fielded system. If “logistics readiness levels” do not meet established standards, corrective action must be taken on both the fielded increments and any subsequent increments under development or production.

The systems and logistics commands of the services and the Defense Logistics Agency (DLA) would have an important role to play in the above process as well. From the inception, they must set standards for logistics readiness levels that are relevant to their environment and to the environment of the logistician, maintainer, or other individual in the field that is supporting the system. These standards-driven logistics assessments must be integrated into the milestone decision process for major systems.[5]

While the elevation of logistics support to the same level as OT&E in terms of independence and influence on the milestone approval process may seem ambitious, it represents a degree of recognition that certain inherent characteristics of the DOD are essentially permanent. Additionally, the bulging PM workload,

already seriously compromised by the inadequate funding of weapon systems and a significant loss of many thousands of qualified government employees essential to acquisition and logistics functions will only increase further under EA. The logistics readiness level “showstopper” will, if used effectively, assist in freezing further work until support issues with previous or current increments are resolved.

Admittedly, measuring logistics performance with respect to a single weapon system is particularly difficult. This is caused by the “horizontal” nature of logistics: physical goods on their way to an operational unit (or on their way back for purposes such as repair, modification, or disposal) cross many different chains of command and involve a variety of commercial transportation and logistics providers. In addition, extensive outsourcing of both weapons system support (sometimes called “product support”), transportation, and logistics activities (which can be bundled in almost any fashion) create a complex patchwork of public- and private-sector activities that can vary not only based on the type of item being supplied, but the origin and destination of that item.

It should also be noted that the overwhelming public focus of the Defense Base Realignment and Closure (BRAC) Commission’s report was on base closures, a little-discussed section dealt with material management and distribution.

Under these recommendations—which are now in effect—all inventory control, management, and distribution of reparable and other items now managed by the individual services is to be reassigned to the DLA, which currently manages mostly consumable and commercial-type items (Defense BRAC Commission, 2005, September 18, pp. 271-279). The DLA's Integrated Data Environment (IDE) and USTRANSCOM's Global Transportation Network (GTN), the two major systems currently managing centralized distribution, are to be merged by the end of FY09 (DLA, 2006, February, p. 9).

---

[5] An example of a publication that could be used as a starting point for such an effort is Department of the Navy (2006, September).

THIS PAGE INTENTIONALLY LEFT BLANK

Conclusion

Evolutionary Acquisition was conceived to resolve an acquisition and funding problem at the Pentagon level, with the added necessary element that support to the warfighter would be expected as well. However, as discussed, EA as currently designed threatens to undermine logistics support and operational availability. Perhaps this is because EA was quickly adapted from the software environment to the full range of weapon systems, or because support considerations were not a priority in preparing the 2003 versions of *DODI 5000.1* and *DODD 5000.2*. Regardless, EA remains a “preferred approach,” and it will be interesting to see how many major acquisition programs adopt this methodology.

We suggest that for EA to maintain or enhance logistics support at the operational level, logistics considerations must be integrated into independent operational testing and into concepts of technology or capability maturity. This may be a radical shift in thinking, which may increase tensions related to the fielding of unsupported or unsupportable equipment throughout the DOD. Whether or not this “user feedback,” as explained in *DODD 5000.2*, is actually incorporated into the criteria for milestone approval for subsequent increments will be a good indicator of how seriously logistics factors will be incorporated into the fielding of future weapon systems.

THIS PAGE INTENTIONALLY LEFT BLANK

List of References

Apte, A. (2004, October 1). *Optimizing phalanx system Lifecycle support* (NPS-LM-04-014). Monterey, CA: Naval Postgraduate School. Retrieved June 28, 2007, from www.acquisitionresearch.org.

Apte, A. (2005, June). *Spiral development: A perspective*(NPS-AM-05-011)*.* Monterey, CA: Naval Postgraduate School. Retrieved June 2007, from www.acquisitionresearch.org.

Barzelay, M. (2001). *The new public management: Improving research and policy dialogue*. Berkeley, CA: University of California Press.

Congressional Research Service (CRS). (2006, May 17). *Evolutionary acquisition and spiral development in DOD programs: Policy issues for Congress* (RS21195). Washington, DC: author.

Defense Acquisition Performance Assessment Project. (2006, February). *Report.* Retrieved June 2007, from www.acq.osd.mil/dapaproject/.

Defense Base Realignment and Closure Commission. (2005, September 18). *Final report to the President.* Chapter 1, section "Supply & Storage," pp. 271-279. Retrieved June 2007, from http://www.brac.gov/finalreport.html.

Defense Logistics Agency. (2006, February). *Strategic plan FY07-FY13.* Retrieved June 28, 2007 from http://www.dla.mil/dla_pubsite/about_dla.aspx.

Department of Defense. (2003, November 24). *Directive Number 5000.1: The defense acquisition system* (DODD 5000.1). Washington, DC: author.

Department of Defense. (2003, May 12). *Instruction Number 5000.2: Operations of the defense acquisition system* (DODI 5000.2). Washington, DC: author.

Department of the Navy. (2006, September). *Department of the Navy guide for performing independent logistics assessments* (NAVSO P-3692). Retrieved June 2007, from https://acc.dau.mil.

Department of the Navy. Program Executive Office Ships. *DDG-51 Guided Missile Destroyer*. Retrieved June 2007, from http://peos.crane.navy.mil/ddg51/default.htm.

Dillard, J.T. (2003, September 29). *Centralized control of defense acquisition programs: A comparative review of the framework from 1987–2003* (NPS-AM-03-009). Monterey, CA: Naval Postgraduate School. Retrieved June 2007, from www.acquisitionresearch.org.

Evolutionary Acquisition: Overview. Retrieved May 12, 2006, from DON Acquisition One Source, www.abm.rda.hq.navy.mil/navyaos/content/view/full/163, June

Federation of American Scientists. *C-130H Spectre and AC-130H Spooky*. Retrieved June 28, 2007, from www.fas.org/man/DOD-101/sys/ac/ac-130.htm.

Federation of American Scientists. *DDG-51 ARLEIGH BURKE Class.* Retrieved June28, 2007, from http://www.fas.org/man/DOD-101/sys/ship/ddg-51.htm.

Farmer, M.E., Frichtman, G.J., & Farkas, K.J. (2003, Spring). Supporting the fleet in the 21st Century: Evolutionary acquisition and logistics. *Air Force Journal of Logistics*, 27(1), 29-34.

Gansler, J.S., & Lucyshyn, W. (2005, August). *A strategy for defense acquisition research*. College Park, MD: Center for Public Policy and Private Enterprise, School of Public Policy, University of Maryland, p. 28. Research partially sponsored by a grant from the Acquisition Research Program, Naval Postgraduate School, Monterey, CA (UMD-AM-05-021).

Government Accountability Office (GAO). (2006, March). *Defense acquisitions: Assessments of selected major weapon programs* (GAO-06-391). Washington, DC: author.

Government Accountability Office (GAO). (2007, March). *Defense acquisitions: Assessments of selected weapon programs* (GAO-07-406SP). Washington, DC: author.

Government Accountability Office (GAO). (2007, January). *High risk series: An update* (GAO-07-310). Washington, DC: author.

Government Accountability Office (GAO). (2006, March 16). *Joint strike fighter: DOD plans to enter production before testing demonstrates acceptable performance* (GAO-06-356). Washington, DC: author.

Government Accountability Office (GAO). (2006, June 20). *Tactical aircraft: DOD should present a new F-22A business case before making further investments* (GAO-06-455R). Washington, DC: author.

Government Accountability Office (GAO). (2007, April). *Tactical aircraft investment strategy* (GAO-07-415). Washington, DC: author.

Hantos, P. (2005, September 30). *Evolutionary acquisition and spiral development tutorial* (Aerospace Report No. TR-2005(8550)-2). El Segundo, CA: The Aerospace Corporation.

Henning, W.A, & Walter, D.T. (2005, December). *Spiral development in action: A case study of spiral development in the Global Hawk Unmanned Aerial Vehicle program* (MBA Professional Report). Monterey, CA: Naval Postgraduate School.

Johnson, W.R., & Birmingham, R.P. (2005, April-July). A multitiered approach to Army acquisition. *Defense Acquisition Review Journal*, 234-246.

Jones, L.R., & Kettl, D.F. (2003). Assessing public management in an international context. *International Public Management Review*, 4(1), 1-19.

Lorell, M.A., Lowell, J.F., & Younossi, O. (2006). *Evolutionary acquisition: Implementation challenges for defense space programs* (MG-431-AF). Santa Monica, CA: RAND.

Nair, V., & Cohen, M.L. (Eds.). (2006). *Testing of defense systems in an evolutionary acquisition environment.* Washington, DC: National Academies Press.

National Aeronautics and Space Administration. *Definition of technology readiness levels.* Undated. Retrieved June 28, 2007, from http://esto.nasa.gov/files/TRL_definitions.pdf.

Pollitt, C., & Bouckaert, G. (2004). *Public management reform: A comparative analysis* (2nd ed.). New York: Oxford University Press.

Software Engineering Institute, Carnegie Mellon University. (2005, May). *CMMI acquisition module (CMMI-AM), Version 1.1* (Technical Report CMU/SEI-2005-TR-011). Retrieved June 2007, from www.sei.cmu.edu.

Stern, D.E., Boito, M., & Younossi, O. (2006). *Systems engineering and program management trends and costs for guided weapons programs* (MG-413). Santa Monica, CA: RAND.

Wellman, G.L. (2003). *A Delphi expert assessment of proactive contracting in an evolutionary acquisition environment* (Thesis—AFIT/GAQ/ENV/03-09). Wright-Patterson AFB, OH: Air Force Institute of Technology.

THIS PAGE INTENTIONALLY LEFT BLANK

2003 - 2006 Sponsored Acquisition Research Topics

Acquisition Management

- Software Requirements for OA
- Managing Services Supply Chain
- Acquiring Combat Capability via Public-Private Partnerships (PPPs)
- Knowledge Value Added (KVA) + Real Options (RO) Applied to Shipyard Planning Processes
- Portfolio Optimization via KVA + RO
- MOSA Contracting Implications
- Strategy for Defense Acquisition Research
- Spiral Development
- BCA: Contractor vs. Organic Growth

Contract Management

- USAF IT Commodity Council
- Contractors in 21st Century Combat Zone
- Joint Contingency Contracting
- Navy Contract Writing Guide
- Commodity Sourcing Strategies
- Past Performance in Source Selection
- USMC Contingency Contracting
- Transforming DOD Contract Closeout
- Model for Optimizing Contingency Contracting Planning and Execution

Financial Management

- PPPs and Government Financing
- Energy Saving Contracts/DOD Mobile Assets
- Capital Budgeting for DOD
- Financing DOD Budget via PPPs
- ROI of Information Warfare Systems
- Acquisitions via leasing: MPS case

- Special Termination Liability in MDAPs

Logistics Management

- R-TOC Aegis Microwave Power Tubes
- Privatization-NOSL/NAWCI
- Army LOG MOD
- PBL (4)
- Contractors Supporting Military Operations
- RFID (4)
- Strategic Sourcing
- ASDS Product Support Analysis
- Analysis of LAV Depot Maintenance
- Diffusion/Variability on Vendor Performance Evaluation
- Optimizing CIWS Life Cycle Support (LCS)

Program Management

- Building Collaborative Capacity
- Knowledge, Responsibilities and Decision Rights in MDAPs
- KVA Applied to Aegis and SSDS
- Business Process Reengineering (BPR) for LCS Mission Module Acquisition
- Terminating Your Own Program
- Collaborative IT Tools Leveraging Competence

A complete listing and electronic copies of published research within the Acquisition Research Program are available on our website: www.acquisitionresearch.org

Initial Distribution List

1. Defense Technical Information Center 2
   8725 John J. Kingman Rd., STE 0944; Ft. Belvoir, VA 22060-6218
2. Dudley Knox Library, Code 013 2
   Naval Postgraduate School, Monterey, CA 93943-5100
3. Research Office, Code 09 1
   Naval Postgraduate School, Monterey, CA 93943-5138
4. Robert N. Beck 1
   Dean, GSBPP
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
5. Keith F. Snider 1
   Associate Professor, GB
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
6. James B. Greene 1
   Acquisition Chair, GB
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
7. Bill Gates 1
   Associate Dean for Research, GB
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
8. Ira Lewis 1
   Associate Professor, GB
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
9. Aruna Apte 1
   Assistant Professor, GB
   555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000
10. Karey L. Shaffer 1
    Program Manager, Acquisition Research Program, GB
    555 Dyer Road, Naval Postgraduate School, Monterey, CA 93943-5000

Copies of the Acquisition Sponsored Research Reports may be printed from our website www.acquisitionresearch.org